Cactus forage productivity modelling using PHYGROW software in a semiarid environment

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INTRODUCTION

Plant growth modeling has been shown an increasing strategy to cope with the high demand for food supply, mainly in climate vulnerable areas, providing them to be used in agriculture worldwide. Concerning semiarid regions, the PHYGROW software has been promising to model plant growth, as cactus forage (“Opuntia stricta” cv. “Mexican elephant ear”) which was used in this study.

OBJECTIVE

To evaluate the prediction capacity of forage cactus biomass using the PHYGROW software in a semiarid environment.

MATERIAL AND METHODS

The data to do the simulations were obtained from a field study conducted at the Biosalinitic Agriculture Prospection and Research field of Embrapa Semiarid, with the following coordinates: -09° 04' 16.4" of latitude and -40° 19' 5.37" of longitude, being 379 meters above sea level. The climate is characterized as a BSwh” type (KÖPPEN 1936). The soil is classified as Plinthic Abrupt Eutrophic Yellow Argisol (SOLOS 2013), with plain relief and middle texture. The cultivar “Orelha de Elefante” of cactus forage [Opuntia stricta (Haw.) Haw.], was sowed in April 2015, in a 1.6 x 0.4 m spacing, performing 15,625 plants/ha. Two data set were used each one with 12 replicates to model its growth. The first data set was obtained from Harvest six months after uniformizing mowing (named year 2017) and the second 12 months after the first harvest (named year 2018). Afterwards, the cactus forage growth was parametrized in PHYGROW, by inserting plant, climate and soil data specific from the study area. The last step after the model has been calibrated consisted of evaluation of the model capacity to predict the plant growth by statistical criteria, how, Determination Coefficient “R²”, Absolute Mean Error, Prediction Mean Error and concordance index “d”.

RESULTS AND DISCUSSION

The cactus forage growth simulation model used two data set, one for 2017 year and the other for 2018 year, when the model was calibrated (Fig 1a). The cactus forage biomass observed in the field was 1745 ± 505.83 and 2016 ± 584.58 kg MS ha⁻¹, in Years 2017 and 2018, respectively, whereas the mean biomass estimated by PHYGROW was 1795 and 2314 kg MS ha⁻¹, respectively (Fig 1b).

CONCLUSION

The PHYGROW model was able to model forage palm growth in Petrolina, Pernambuco, Brazil. This study also demonstrated the importance of modeling to help farmers deal with climatic and food variations in climate-vulnerable areas, enabling them to anticipate and adopt strategies to deal with drought more efficiently.

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Fig 1 – Cactus forage biomass (kg DM ha⁻¹) predicted by PHYGROW (a) and Statistics to evaluate the model capacity to simulate cactus forage growth in Petrolina, Pernambuco, Brazil.